Chapter H1: Background

This case study presents the results of an analysis performed by EPA to assess the potential benefits of reducing the cumulative impacts of I&E at CWIS at the J.R. Whiting plant, a Great Lakes facility located on Lake Erie. Section H1-1 of this background chapter provides a brief description of the facility, Section H1-2 describes the environmental setting, and Section H1-3 presents information on the area's socioeconomic characteristics.

CHAPTER CONTENTS

H1-1 Overview of J.R. Whiting Facility

The J.R. Whiting power plant is a 346 MW power plant located on Lake Erie. It began commercial service in 1952 and currently operates three coal-fired steam-electric units and one oil-fired gas turbine. J.R. Whiting had 134 employees in 1999 and generated 2.1 million MWh of electricity. Estimated baseline revenues in 1999 were $141 million, based on the plant's 1999 estimated electricity sales of 2.0 million MWh and the 199 company-level electricity revenues of $71.14 per MWh. J.R. Whiting's 1999 production expenses totaled $44 million, or 2.060 cents per kWh, for an operating income of $97 million.

The facility is located at Luna Pier, Michigan, on the Woodtick Peninsula, 10 miles north of Toledo, Ohio, and 35 miles south of Detroit, Michigan (Figure H1-1).

❖ ***Ownership Information***

J.R. Whiting is a regulated utility plant owned by Consumers Energy Co., a subsidiary of CMS Energy Corporation. CMS Energy Corporation is an energy holding company with over 11,600 employees. The firm owns or controls almost 8.1 million megawatts of electric generating capability. In 2000, CMS posted sales of $9.0 billion and sold 41.0 million MWh of electricity (Hoover's Online, 2001c; CMS, 2001).

Table H1-1 below summarizes the plant characteristics of the J.R. Whiting plant.

Table H1-1: Summary of J.R. Whiting Plant Characteristics (1999).

	J.R. Whiting
Plant EIA Code	1723
NERC Region	ECAR
Total Capacity (MW)	346
Primary Fuel	Coal
Number of Employees	134
Net Generation (million MWh)	2.1
Estimated Revenues (million dollars)	141
Total Production Expense (million dollars)	44
Production Expense (¢/kWh)	2.060
Estimated Operating Income (million dollars)	97

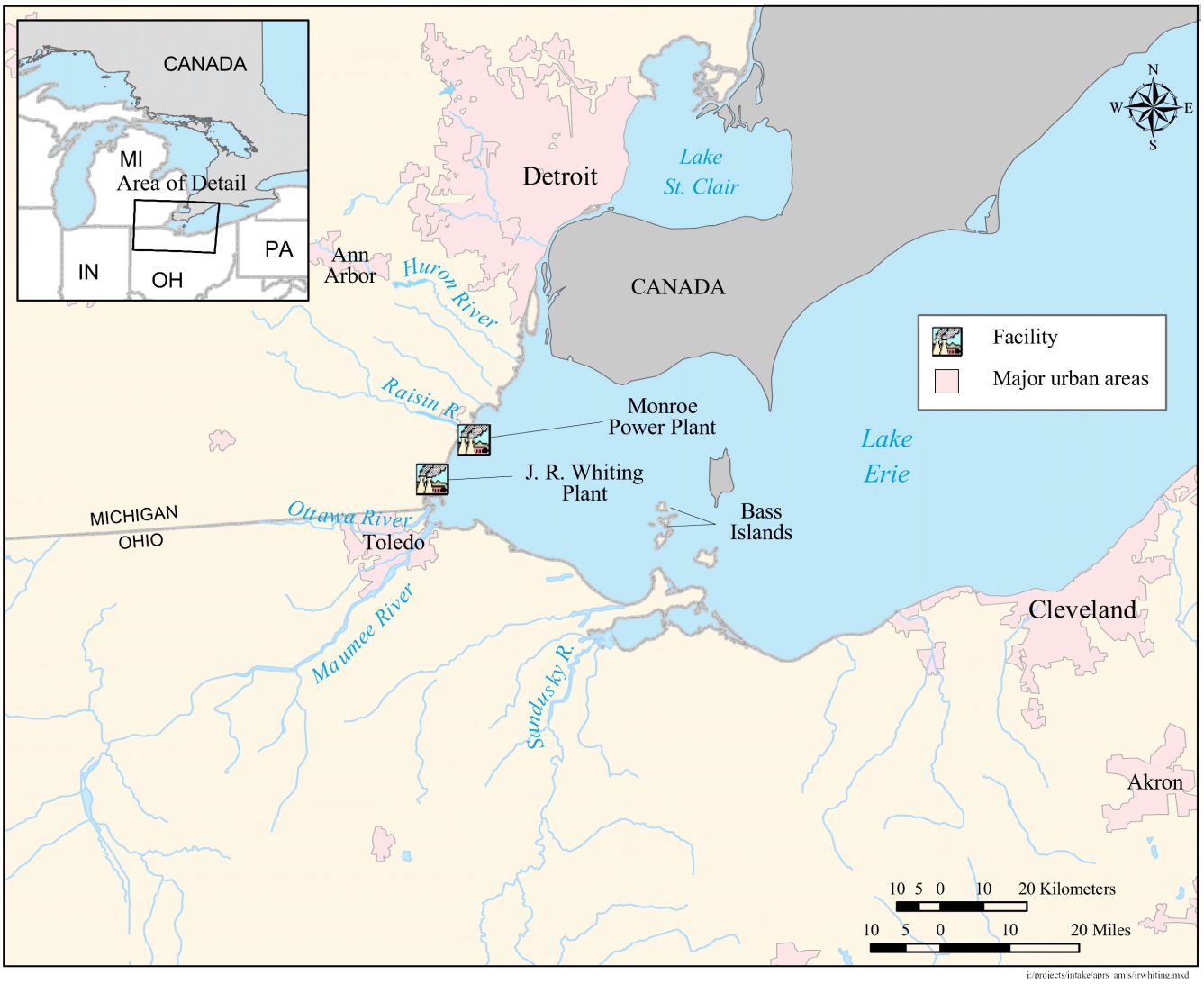
Notes: NERC = North American Electric Reliability Council
ECAR = East Central Area Reliability Coordination Agreement
Dollars are in $2001.

Source: Form EIA-860A (NERC Region, Total Capacity, Primary Fuel); FERC Form-1 (Number of Employees, Total Production Expense); Form EIA-906 (Net Generation).

The Monroe power plant (evaluated in Part I) is located just to the north, where the Raisin River enters Lake Erie, as indicated in Figure H1-1.

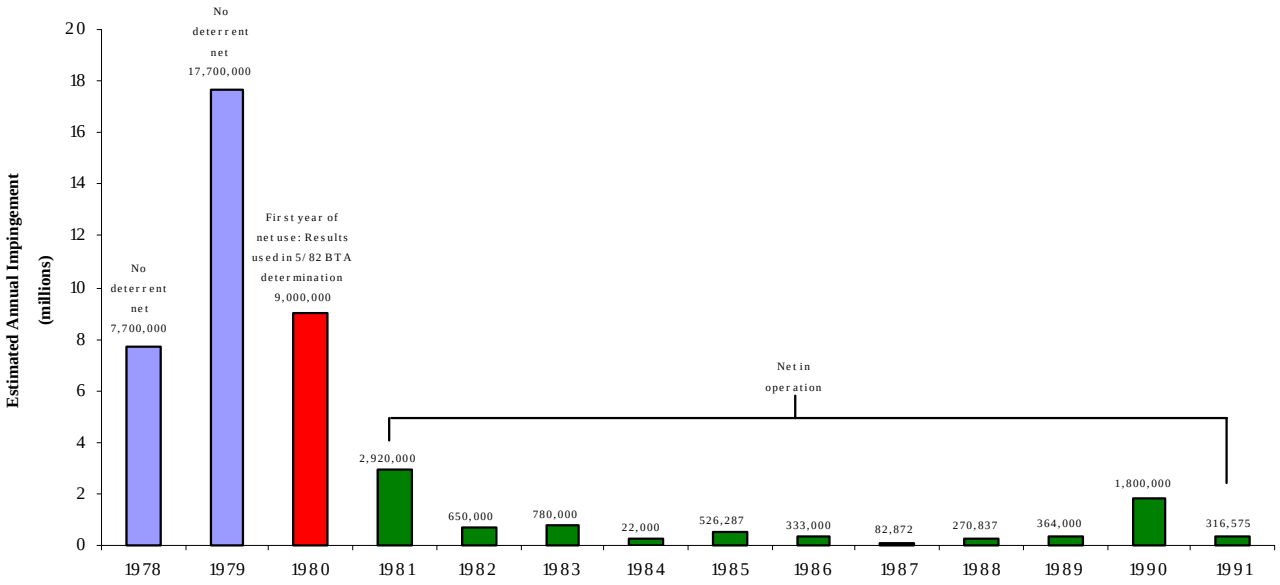
Consumer Power's J.R. Whiting facility has one cooling water intake structure serving one once-through cooling system. The facility withdraws cooling water from North Maumee Bay (located in western Lake Erie) via a recessed shoreline intake at the lake surface. The intake has a fish deterrent net located across the recessed portion of the shoreline and a dual entry/single exit traveling screen. The design intake capacity of the intake is 308 MGD.

Figure H1-1: Locations of the J.R. Whiting and Monroe Facilities Within the Great Lakes Region



In 1980, a deterrent net was installed to reduce high impingement of gizzard shad *(Dorosoma cepedianum*), emerald shiner (*Notropis atherinoides)*, spottail shiner (*Notropis hudsonius*), yellow perch *(Perca flavescens*), and several other lake fishes (Consumers Power Company, 1984). Studies indicate that the net has dramatically reduced impingement rates (Consumers Power Company, 1984, 1994; Figure H1-2).

Figure H1-2: Estimated Annual Fish Impingement of All Species at Consumers Powers Company's J.R. Whiting Plant, 1978-1991



Source: Consumers Power Company, 1984; 1994.

H1-2 Environmental Setting

H1-2.1 Lake Erie

Lake Erie has 1,402 km (871.2 miles) of coastline and a surface area of 25,657 km^2 (9,906.2 mi^2) (U.S. EPA, 2001a). With an average depth of only 19 m (62 ft), Lake Erie is by far the shallowest of the Great Lakes (University of Wisconsin Sea Grant, 2001), and therefore the most susceptible to storms, wind tides, and seiches (U.S. EPA, 2000). Its shallowness results in considerable temperature variations throughout the year. Lake Erie warms quickly in the spring and summer and cools rapidly in the fall (U.S. EPA, 2000). During particularly long, cold winters a large part (or sometimes all) of the lake may freeze over.

Lake Erie has undergone drastic biological changes during the past 20 years (U.S. EPA, 2000). Although the water was once severely polluted, water clarity has improved dramatically as a result of stricter water pollution controls as well as filtering by expanding populations of the introduced zebra mussel (U.S. EPA, 2000).

H1-2.2 Aquatic Habitat and Biota

Lake Erie consists of three relatively distinct aquatic regions: the western, central, and eastern basins (U.S. EPA, 2000). The central and eastern basins are deep, with depths reaching approximately 29 and 53 m (95 and 175 ft) respectively. They have low flushing rates and exhibit noticeable thermal stratification. The western basin, from which J.R. Whiting withdraws its water, is the shallowest of the three basins. With an average depth of only 7.4 m (24 ft) and a maximum depth of 19 m (82 ft) (U.S. EPA, 2000), the western basin is so shallow that its entire depth is stirred by wind action. The cycling motion of the water resuspends bottom sediments in the water column and makes stratification very rare and brief. The shallow depth of the basin also results in warmer water and relatively high biological productivity in the area surrounding the J.R. Whiting facility.

Historically, benthic organisms, animals that live on or in association with the bottom of the lake, have been dominant in the western basin. These organisms find an abundance of food in the organic load deposited by the Detroit and Maumee rivers directly into the basin. Though it receives a high sediment loading, most sediment eventually moves to the central and eastern basins. The west basin's shallow sandbanks also provide ideal spawning habitat for fish from all three basins (U.S. EPA, 2000). Typical fish found in Lake Erie include bowfin, brown trout, carp, chinook salmon, coho salmon, freshwater drum, lake herring, lake sturgeon, lake trout, lake whitefish, longnose sucker, rainbow smelt, pumpkinseed, and rock, white, and smallmouth bass (University of Wisconsin Sea Grant, 2001).

The Lake Erie shore is composed of silty-clay soils and is predominantly steep with very little beach area (Dodge and Kavetsky, 1995). Shoreline erosion, caused by the stirring of the lake, results in milky-colored inshore waters. In contrast, offshore waters are much more transparent. Wind in the central basin causes strong along-shore currents and undertows that build peninsulas by pulling sediments from the shores. The peninsulas shelter significant remaining wetlands and create bays that provide spawning and nursery habitat for several fish species.

On the U.S. side, Lake Erie once had significant wetlands, including the 4,000 km^2 (1544 mi^2) Black Swamp at the Maumee River (Dodge and Kavetsky, 1995). However, the Black Swamp has been reduced to 100 km^2 (39 mi^2) by agricultural activities, including conversion. An especially severe problem for Lake Erie's wetland habitats is agricultural nutrients and sediments, which cause a high level of turbidity. Suspended sediments in the water prevent the establishment of submergent vegetation and adversely affect the aquatic ecosystem.

Compared to the other Great Lakes, Lake Erie has few areas of rocky substrate for fish spawning. Virtually all such habitat is encrusted with zebra and quagga mussels, except for areas where waterfowl or fish predation and ice scour limit mussels to the sheltered sides of rocks. In addition, the rocky substrates of Lake Erie have also been degraded by algal growth and sedimentation, further limiting fish spawning habitats. In the Detroit River, contaminated sediments are thought to be affecting fish eggs. On the Grand River, dams have limited the upstream migration of walleye (Dodge and Kavetsky, 1995).

H1-2.3 Major Environmental Stressors

The large human population surrounding Lake Erie has led to a number of major stresses on the aquatic environment (U.S. EPA, 2000). Nonpoint source pollution combined with the productive waters of the western basin have at times (particularly 1950-1970) resulted in accelerated eutrophication, large algal blooms, and anoxic waters. Overfishing and the introduction of non-native species have hurt some fish populations, though control efforts for both overfishing and invasive species have helped populations to rebound in recent years (U.S. EPA, 2000).

a. Habitat alteration

The western area of Lake Erie once had an extensive coastal marsh and swamp system stretching from the Detroit River to Maumee Bay, but most marshes were cleared and drained throughout the 1900's (Dodge and Kavetsky, 1995). About 5300 ha (13,100 acres) of wetlands remain in Ohio, but Michigan's Lake Erie shoreline wetlands have been reduced to only 100 ha (247 acres). Remaining wetlands have been severely degraded.

The Woodtick Peninsula, where J.R. Whiting is located, serves as a barrier beach protecting the wetlands behind it from wave erosion (U.S. EPA, 2001a). However, the peninsula itself is now being eroded as the sediment drift that once replenished it has been diminished by structures built to protect shoreline properties. As the Peninsula erodes, so too do the wetlands.

b. Introduction of nonnative species

The introduced zebra mussel became established in large numbers in Lake Erie the late 1980's and early 1990's (U.S. EPA, 2000). As in the other Great Lakes, zebra mussels have altered habitat, the food web dynamic, energy transfer, and how nutrients are cycled in the lakes. However, filtering by zebra mussels has apparently contributed to a dramatic increase in Lake Erie's water clarity. A preferred course of action on how to deal with the zebra mussels has not been established by the Lake Erie Lakewide Management Plan Committee (U.S. EPA, 2000).

c. Overfishing

Lake Erie has historically encountered problems of overfishing, particularly in the late 1800s (Egerton, 1985). In this century, the exact impact of overfishing has been debated because decreases in stocks may also be attributed to pollution, invasive species, and habitat degradation (Egerton, 1985). Ultimately, the governments of the Great Lakes states and provinces came together to form the Great Lakes Fishery Commission in 1955, and since then the Commission has studied the issues and set commercial and recreational fishing quotas to help maintain important fish species (U.S. EPA, 2000).

d. Pollution

Discharges to Lake Erie of persistent toxic chemicals were banned in the 1970s, but effects of these historic discharges continue to linger (U.S. EPA, 2000). Two sites near the J.R. Whiting facility have been designated as Areas of Concern (AOC): the Maumee AOC, which resulted from high concentrations of PCBs in the Maumee River drainage area, and the River Raisin AOC, caused by historical discharges of oils and grease, heavy metals, and PCBs into the River Raisin (U.S. EPA, 2000).

The presence of PCBs has resulted in fish consumption advisories being issued for Lake Erie, the Ottawa River and the Raisin River (see Table H1-2). The Ottawa River, in the Maumee drainage area, has the highest fish contaminant concentrations and the most restrictive fish consumption advisories. The River Raisin and the Lake Erie FCAs are milder (MDCH, 2001).

Table H1-2: State of Michigan Fish Consumption Advisories for Lake Erie, Ottawa River, and River Raisin, 2001[a]

	Fish Length (in.)								
	6-8	8-10	10-12	12-14	14-18	18-22	22-26	26-30	30+
Lake Erie									
Carp	◆	◆	◆	◆	◆	◆	◆	◆	◆
Catfish	◆	◆	◆	◆	◆	◆	◆	◆	◆
Chinook salmon			▲/■	▲/■	▲/■	▲/■	▲/■	▲/■	▲/■
Coho salmon			▲/■	▲/■	▲/■	▲/■	▲/■	▲/■	▲/■
Freshwater drum	▲/▼	▲/▼	▲/▼	▲/▼	▲/▼	▲/▼	▲/▼	▲/▼	▲/▼
Lake trout			▲/❖	▲/❖	▲/❖	▲/❖	▲/❖	▲/❖	▲/❖
Rainbow trout			▲/■	▲/■	▲/■	▲/■	▲/■	▲/■	▲/■
Smallmouth bass					▲/■	▲/■	▲/■	▲/■	
Walleye				▲/▼	▲/▼	▲/▼	▲/■	▲/■	▲/■
White bass	▲/■	▲/■	▲/■	▲/■	▲/■	▲/■			
Whitefish	▼/◆	▼/◆	▼/◆	▼/◆	▼/◆	▼/◆	◆	◆	◆
White perch	▲/■	▲/■	▲/■	▲/■					
Yellow Perch	▲/▼	▲/▼	▲/▼	▲/▼	▲/▼	▲/▼			
Ottawa River									
All species	◆	◆	◆	◆	◆	◆	◆	◆	◆
River Raisin (below Monroe Dam)									
Carp	◆	◆	◆	◆	◆	◆	◆	◆	◆
Freshwater drum	▲/■	▲/■	▲/■	▲/■	▲/■	▲/■	▲/■	▲/■	▲/■
Smallmouth bass					▼/❖	▼/❖	▼/❖	▼/❖	
White bass	▲/❖	▲/❖	▼/❖	◆	◆	◆			

◆ = No consumption.
❖ = Limit consumption to 6 meals (½ pound) per year.
■ = Limit consumption to 1 meal (½ pound) per month.
▼ = Limit consumption to 1 meal (½ pound) per week.
▲ = Unlimited consumption

[a] If there is only one symbol it is the advice for the whole population. When two symbols are shown, the first is the advice for the "general population" and the second is the advice for "children age 15 and under and women who are pregnant, nursing, or expect to bear children."

Source: MCDH, 2001.

H1-3 Socioeconomic Characteristics

The J.R. Whiting plant is located in Monroe County, Michigan, a rural county bordered to the east by Lake Erie and to the north and south by more urban counties (Wayne County, Michigan and Lucas County, Ohio). In 2000, Monroe had a population of 145,945, a high rate of home ownership, and a higher median income than surrounding counties (U.S. Census Bureau, 2001). The socioeconomic characteristics of Monroe and neighboring counties are summarized in Table H1-3.

Table H1-3: Socioeconomic Characteristics of Monroe and Neighboring Counties.

	Monroe County, MI	Wayne County, MI	Lucas County, OH
Population in 2000	145,945	2,061,162	455,054
Land area in 2000, km^2 (mi^2)	1,427 (551)	1,590 (614)	881 (340)
Persons per square mile, 2000	265	3,357	1,338
Metropolitan Area	Detroit, MI	Detroit, MI	Toledo, OH
Median household money income, 1997 model-based estimate	$48,607	$35,357	$37,064
Persons below poverty, percent, 1997 model-based estimate	7.60%	18.00%	13.60%
Housing units in 2000	56,471	826,145	196,259
Homeownership rate in 2000	81.00%	66.60%	65.40%
Households in 2000	53,772	768,440	182,847
Persons per household in 2000	2.69	2.64	2.44
Households with persons under 18 years in 2000	39.10%	37.70%	34.10%
High school graduates, 25 and older in 1990	60,968	926,603	221,052
College graduates, 25 and older in 1990	8,655	180,822	49,393

Source: U.S. Census Bureau, 2001.

H1-3.1 Major Industrial Activities

Monroe County produces agricultural products such as soybeans, grains, corn, sugar beets, potatoes and alfalfa, and industrial processes such as auto-parts manufacturing, metal fabrication, cement, packaging and glass production (InfoMI, 2001). Luna Pier, where J.R. Whiting is located, is primarily a resort town with a sandy beach and a half mile crescent shaped pier stretching out into Lake Erie (InfoMI, 2001).

H1-3.2 Commercial Fisheries

Commercial fishing on Lake Erie has generated between $2 million and $3 million of revenue per year for the last decade (USGS, 2001c). A small share of this catch comes from the Michigan waters. Tables H1-4 and H1-5 show the pounds harvested and the revenue generated for the Michigan Lake Erie commercial fishery from 1985 to 1999. Despite fish consumption advisories, carp is the most important commercial species, comprising 72 percent of the catch and 51 percent of revenues over this 15-year period. Channel catfish, quillback, and bigmouth buffalo make up most of the remaining harvest and revenue (USGS, 2001c).

H1-3.3 Recreational Fisheries

Lake Erie fish species also help support several charter boat companies. In 1997, Lake Erie charter boats reported 1,727 excursions with 8,284 anglers (Rakoczy and Wesander-Russell, 1998). Ninety percent of these anglers were local residents. About half of the 74,000 fish caught on charter boats that year were walleye and about half were yellow perch (Rakoczy and Wesander-Russell, 1998).

Recreational anglers spent about 175,000 noncharter days fishing the Michigan waters of Lake Erie in 1994 (Rakoczy and Svoboda, 1997). Their most commonly caught species were yellow perch and walleye (44 percent and 35 percent of the total harvest, respectively). White bass, channel catfish, freshwater drum, and white perch made up most of the remaining catch.

Total recreational hours (including charter) spent fishing Michigan's Lake Erie dropped in the early 1990s (see Table H1-6), but the reasons for this are unclear. Some of the reduction in fishing days may be related to declines in species such as yellow perch. However, Thomas and Haas (2000) note that the apparent declines in yellow perch and other species may reflect lower catchability resulting from an improved ability to avoid fishing gear because of improved water clarity rather than actual population reductions.

❖ ***The Linesville, PA Spillway at Pymatuning State Park: "Where Ducks Walk on Fishes' Backs"***

Carp swarm above and below the spillway. They compete with ducks and Canada geese for slices of bread tossed to them by visitors. The ducks clamor over the seemingly endless school of carp to get their share. The ducks actually walk on the back of the carp.

The Spillway is a popular recreational site where visitors bring old bread or buy it at a nearby concession stand. Birds and fish compete for the bread. The spillway is the outflow of a secondary impoundment at the 2500 acre Pymatuning reservoir / sanctuary that serves as fish propagation waters for the Linesville Fish Culture Station.

Source: http://www.sideroads.com/outdoors/spillway.html
Photos: © Lynne G. Tudor

Table H1-4: Pounds of Commercial Landings in the Michigan Waters of Lake Erie

Species	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Gizzard shad	878,000							2,845	395	2,103	23	36,996	24,494	4,988	6,200
Brown bullhead	7,340	7,687	4,462	5,421	3,572	488	704	444	844	659	827	828	744	2,139	7,050
Channel catfish	9,253	11,183	39,603	15,208	11,481	2,025	1,941	2,929	9,152	5,760	16,168	24,969	17,936	16,573	7,561
White perch							8	10			64	45	4		
White bass	4,764	1,397	4,142	1,049	991		19	357	1,180	1,819	1,850	2,923	7,306	1,326	23
Freshwater drum	905	2,032	1,825	1,180				290	4,206	111	39,673	48,218	8,823	24,507	265
Gars									441	68		27	90	279	
Suckers	1,378	123	88								436	4,286	72	6,180	1,945
Goldfish			551	188	2,951	877	8,416	1,025	501	111	517	7,138	10,497	6,862	
Carp	738,857	367,310	685,395	417,365	194,320	158,151	198,294	251,365	238,805	94,662	329,262	387,671	325,433	620,015	211,055
Quillback	87,326	2,217	1,062	1,380	568		6,894	30,204	28,175	8,930	66,013	73,662	33,937	22,990	
Bigmouth buffalo	577	14,732	17,814	9,471	19,549	40,064						104	91,877	15,721	25,894
Totals	1,728,400	406,681	754,942	451,262	233,432	201,605	216,276	289,469	283,699	114,223	454,833	586,867	521,213	721,580	259,993

Source: USGS, 2001c.

Table H1-5: Revenue from Commercial Landings in the Michigan Waters of Lake Erie

Species	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999
Gizzard shad	$241,450							$342	$40	$274	$1	$4,809	$1,714	$350	$744
Brown bullhead	$1,834	$1,888	$1,076	$1,355	$895	$123	$171	$122	$213	$185	$189	$209	$253	$599	$1,904
Channel catfish	$5,364	$6,453	$23,201	$9,114	$6,898	$1,215	$1,138	$1,569	$5,580	$3,628	$10,189	$14,236	$9,684	$9,281	$4,461
White perch							$4	$5			$42	$28	$2		
White bass	$1,219	$1,073	$3,209	$629	$488		$18	$374	$1,191	$1,474	$1,702	$2,661	$6,213	$1,074	$18
Freshwater drum	$89	$185	$187	$472				$28	$462	$22	$7,538	$7,714	$1,411	$4,168	$48
Gars										$17		$11	$45	$112	
Suckers	$155	$7	$6								$26	$256	$5	$371	$253
Goldfish			$827	$47	$495	$201	$1,689	$308	$126		$130	$2,929	$3,466	$2,745	
Carp	$85,409	$38,937	$79,199	$63,611	$26,000	$19,590	$23,794	$30,612	$31,044	$12,306	$36,222	$46,521	$45,562	$80,601	$27,438
Quillback	$5,086	$170	$106	$139	$227		$2,661	$12,856	$10,144	$3,130	$22,446	$26,516	$6,449	$4,598	
Bigmouth buffalo	$292	$6,060	$7,148	$3,975	$8,332	$16,358						$47	$40,425	$8,018	$11,913
Totals	$340,898	$54,773	$114,959	$79,342	$43,335	$37,487	$29,475	$46,216	$48,800	$21,036	$78,485	$105,937	$115,229	$111,917	$46,779

Source: USGS, 2001c.

Table H1-6: Michigan Lake Erie Boat Fishery Angler Effort and Primary Species Catch April Through October, 1986 to 1998

	Angler Hours	Number of Yellow Perch Harvested	Number of Walleye Harvested
1986[a]	2,068,779	834,310	605,666
1987	2,455,903	619,112	902,378
1988[b]	4,362,452	318,786	1,996,824
1989	3,799,067	1,466,442	1,092,289
1990	2,482,242	770,507	780,508
1991[a]	805,294	378,716	132,322
1992	836,216	255,747	249,713
1993	935,249	473,580	270,376
1994	1,012,595	246,327	216,040
1995	na	343,240	107,909
1996	na	635,233	174,607
1997	na	529,435	112,400
1998	na	586,277	114,607

[a] May through October.
[b] May through September.
na = not available.
Sources: Rakoczy and Svoboda, 1997; Thomas and Haas, 2000.